R E P O R T R E S U M E S

ED 014 772 24 CG 000 975

RESEARCH CONFERENCE ON "LEARNING BY DISCOVERY" (NEW YORK CITY, JANUARY 28-29, 1965).

BY- CRONBACH, LEE J.
STANFORD UNIV., CALIF.

REPORT NUMBER CRP-F-064 PUB DATE JAN 65
REPORT NUMBER BR-5-0349
EDRS PRICE MF-$0.25 HC-$0.64 14P.

DESCRIPTORS- *RESEARCH, CURRICULUM DEVELOPMENT, *CONFERENCES, *DISCOVERY PROCESSES, *LEARNING, PROBLEM SOLVING, INDIVIDUAL CHARACTERISTICS, REVIEW (REEXAMINATION)

A TWO DAY RESEARCH CONFERENCE ON "LEARNING BY DISCOVERY" WAS HELD TO--(1) CLARIFY SOME OF THE ISSUES INVOLVED IN LEARNING BY DISCOVERY, (2) REVIEW WHAT IS KNOWN OF THE SUBJECT, AND (3) SUGGEST WAYS OF EXTENDING KNOWLEDGE ABOUT IT. THE 25 PARTICIPANTS WERE REPRESENTATIVES FROM MANY AREAS IN PSYCHOLOGY AND EDUCATION. OBSERVERS FROM GOVERNMENT AGENCIES WERE ALSO INVITED. AT THE FIRST SESSION, TWO VERY DIFFERENT VIEWPOINTS WERE PRESENTED TO CLARIFY SOME OF THE ISSUES IN THE FIELD. A SECOND SESSION WAS LARGELY CONCERNED WITH A CRITICAL REVIEW OF PREVIOUS WORK IN THE FIELD. THE THIRD SESSION DEALT WITH CURRICULUM PROJECTS. THE FOURTH SESSION COVERED PROBLEM SOLVING AND PERSONALITY VARIABLES. THE FIFTH SESSION WAS RESERVED FOR SUMMARY STATEMENTS AND GENERAL DISCUSSION. THE CONFERENCE APPEARED TO BRING THE COMPLEXITY OF THE PROBLEM INTO FOCUS. THE VERY PHASE "LEARNING BY DISCOVERY" APPEARS TO HAVE A VARIETY OF MEANINGS. RESEARCH WHICH GREW OUT OF THE CONFERENCE WAS ANALYZED AND DISCUSSED FOR THE FIRST TIME. SUGGESTIONS ABOUT THE WAYS IN WHICH THE DISCOVERY PROCESS MAY BE GUIDED AND THE WAY RESEARCH QUESTIONS SHOULD BE POSED ARE MADE. THE PROCEEDINGS OF THE CONFERENCE HAVE BEEN PUBLISHED BY RAND-MCNALLY AND COMPANDY AS "LEARNING BY DISCOVERY--A CRITICAL APPRAISAL."(SK)

ED014772

RESEARCH CONFERENCE ON "LEARNING BY DISCOVERY"

New York City, January 27-28, 1965

Cooperative Research Project No. F-064

ED014772

BR 5-0349
PA-24

RESEARCH CONFERENCE ON "LEARNING BY DISCOVERY"

New York City, January 28-29, 1965

Cooperative Research Project No. F-064

under contract with

Stanford University, Stanford, California

In cooperation with

The Committee on Learning and the Educational Process of the

Social Science Research Council

Principal Investigator, Lee J. Cronbach

Conference Committee Chairman, Evan R. Keislar

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

The Activity herein was supported by the Cooperative Research Program of the Office of Education, U. S. Department of Health, Education, and Welfare.

CG 000 975

Introduction

This report summarizes the activities carried out in connection with a research conference on "Learning by Discovery" held in New York City on January 28th and 29th, 1965. The conference, which was supported by the U. S. Office of Education through a contract with Stanford University, was initiated by the Committee on Learning and the Educational Process of the Social Science Research Council. The members of this Committee at the time the original plans were made were as follows: Lee J. Cronbach, Stanford University, Chairman; Eleanor J. Gibson, Cornell University; Richard C. Atkinson, Stanford University; Evan R. Keislar, University of California, Los Angeles; Judson C. Shaplin, Washington University; and Ben Willerman, for the Social Science Research Council. Late in 1964, Shaplin and Willerman were replaced by George Miller, Harvard University; Lloyd Morrisett, Carnegie Corporation of New York; and Rowland Mitchell for the Social Science Research Council. The Committee proposed the conference in order to (1) clarify some of the issues involved in learning by discovery, (2) review what is now known about this subject, and (3) suggest ways of extending knowledge about it.

Planning of the Conference

The subcommittee which was appointed to plan the conference consisted of: Robert Gagné, American Institute for Research, Pittsburgh; Jerome Kagan, Harvard University; and Evan R. Keislar, Chairman. Primary responsibility for the preparation of this report was taken by Keislar. The subcommittee conducted almost all of its work by correspondence and telephone. On three occasions the chairman had the opportunity to meet in person with one member of the committee; the committee as a whole never met until the day of the conference.

In drawing up the list of participants, an effort was made to include representatives from a variety of fields in psychology and education. Provision was also made for observers from government agencies. The participants were selected from the following categories:

(1) Persons who have been active in conducting research in the field of "Learning by Discovery."

(2) Individuals engaged in the construction of curricula that incorporate the principle of "Learning by Discovery."

(3) Outstanding researchers in experimental psychology who have been working with concept formation and problem solving.

(4) Individuals who are competent in experimental design and methodology of educational research.

The participants who attended the conference are listed in Appendix A. Most of these persons properly belong to more than one of the above categories. Although many other highly qualified individuals could have been selected to attend the conference, it was decided to limit the total number of participants to twenty-five; experience with previous conferences had indicated that group discussions could not be efficient if the number of participants was larger than this.

In planning for the conference, the sub-committee decided that it would be important for all participants to be well acquainted with previous research in the field. One member of the conference, Merl Wittrock, was commissioned to prepare a comprehensive summary of the research and writing in this area. The report was mimeographed and distributed to all conference participants in December, 1964, more than a month prior to the conference.

The general plan formulated by the sub-committee was for a two-day conference consisting of a total of five periods; a morning, afternoon, and evening session were planned for the first day. Two sessions were scheduled for the second day allowing participants to return home at the close of the afternoon discussion. For the opening period, it was felt desirable to have the issues in this field clarified by presenting two very different points of view. In this way, the conference members might come to grips with the central problem being posed by the conference.

A critical review of the previous work in the field was scheduled for the second session. At this time the conference had an opportunity to react to Wittrock's review of literature mailed to them before the conference, as well as to hear a critical analysis of this report. The third session dealt with the contribution of curriculum projects, since the principle of "Learning by Discovery" has been an avowed feature of the newer curriculum reforms. It was felt that leaders in this field would be helpful in indicating progress made in these directions.

In order to suggest promising directions for research work, two papers were scheduled for the fourth session, treating different aspects of the question. One of these dealt with the general field of problem solving, and the other with personality variables. The final session was reserved for a summary statement by two of the participants followed by a general discussion.

New York City was selected as a site for the conference simply because this location was the most convenient for all participants; the total amount of travel for those attending the conference was therefore kept at a minimum. The staff of the Social Science Research Council made all arrangements for the housing of the conference at the Hotel Summit, 51st and Lexington Avenue, New York City. A conference room, which was the ideal size for this meeting, was obtained in the hotel, and facilities were arranged to provide complete tape recording of all papers and discussions.

The Conference in Action

The final program of the conference as it actually took place is presented below. The general procedure for each of the five sessions was to have two speakers followed by discussion.

PROGRAM

RESEARCH CONFERENCE ON "LEARNING BY DISCOVERY"

FIRST SESSION: Thursday, January 28, 9:30 a.m., Evan Keislar, Chairman

1. Topic: Variables in Discovery Learning
   Speaker: Robert Glaser
2. Topic: Learning the Unteachable
   Speaker: David Hawkins
   Discussion

SECOND SESSION: Thursday, January 28, 1:30 p.m., Lloyd Morrisett, Chairman

3. Topic: The Learning by Discovery Hypothesis: A Review of Literature
   Speaker: M. C. Wittrock
4. Topic: The Logic of Experiments on Discovery
   Speaker: Lee J. Cronbach
   Discussion

THIRD SESSION: Thursday, January 28, 8:00 p.m., Jerome Kagan, Chairman

5. Topic: Some Elements of Discovery
   Speaker: Jerome S. Bruner
6. Topic: Discovery in the Teaching of Mathematics
   Speaker: Robert B. Davis
   Discussion

FOURTH SESSION: Friday, January 29, 9:30 a.m., Richard Atkinson, Chairman

7. Topic: Varieties of Learning and the Concept of Discovery
   Speaker: Robert M. Gagné
8. Topic: Learning, Attention, and the Issue of Discovery
   Speaker: Jerome Kagan
   Discussion

FIFTH SESSION: Friday, January 29, 1:30 p.m., Robert Gagne, Chairman

9. Topic: Summary of the Conference
   Speakers: Howard H. Kendler
   Lloyd N. Morrisett
   Discussion

ADJOURNMENT: Friday, January 29, 3:30 p.m.

The general procedure of having two papers with discussion at each session seemed to work well. At the second session, Wittrock did not read the review of the literature (which had been distributed to the conference earlier). Instead, he summarized informally the major parts of the report. At the evening session, Robert Davis concluded his presentation by showing to the conference a 20-minute sound film to illustrate his use of learning-by-discovery methods in the classroom.

At each session the papers always provoked a lively discussion. Many of the speakers were interrupted during the presentation of their papers by questions from the floor frequently resulting in a discussion for several minutes. The subjects for these discussions ranged very widely. It was not possible, nor perhaps desirable, to keep the group focussed on a single topic for an extended period of time. The discussion in later sessions would frequently pick up an issue which had been raised in an earlier interchange. In fact, as evidenced by the taped records, some issues were discussed repeatedly at every one of the five sessions.

Although there was variation in the extent to which individuals spoke during the discussions, there appeared to be adequate representation of the different groups from which members had been drawn. Experimental psychologists, for example, contributed to the discussions fully as much as those more interested in curriculum development.

An important aspect of the conference was the informal discussion carried on after the regular sessions. For lunch each day, but not for dinner, the members of the conference met at several tables in an adjacent dining room. After the evening session was formally concluded, several groups of individuals carried on discussions informally far into the evening.

Dissemination of the Conference Proceedings

The proceedings of the conference have been prepared for publication. Arrangements have been made to publish the proceedings as a volume by Rand-McNally and Company under the title, "Learning by Discovery - A Critical Appraisal," edited by Shulman and Keislar. Publication should be completed during the spring of 1966. An outline of the contents of this book is presented in Appendix B.

The book is organized into five sections roughly corresponding to the five conference sessions. In the first four sections will appear the eight papers, two per section, most of which were revised by their authors following the conference for this publication. The discussions of all papers have been summarized from the tape recordings and regrouped into four major topics to correspond to the subjects of the four sections. The two papers for each section, therefore, are followed by a summary of all pertinent discussions on that subject.

The final section of the volume includes the two summaries of the conference by Kendler and Morrisett, along with a concluding statement by the editors. At the end of the book all references have been organized into a single bibliography followed by an Appendix.

An Evaluation of the Conference

There will probably not be complete consensus among the conference members regarding the contributions of the conference. The question of "Learning by Discovery," as much as any other issue, deals with the heart of education. This centrality is reflected in the fact that included in the discussion were a host of fundamental questions such as: the nature of knowledge, epistemological issues, the relation of the individual to society, the concept of free will, moral questions involved in the control of human behavior, and the ultimate goals of education. Among the many important outcomes of the conference are the following:

The conference brought the complexity of the problem clearly into focus. It became evident that the phrase "Learning by Discovery" had a variety of meanings. Some participants distinguished between two classes of phenomena which have been described by the work "discovery." They distinguished between small discoveries, "little d," such as the discovery of a rule, and large discoveries, "big D," involving a fundamental reorganization of cognitive structure.

One speaker indicated that discovery was involved in many kinds of learnings. For example, a student in a golf class may discover how to hit a golf ball. He may also master a list of paired-associate words by discovering appropriate mediators. Others pointed out that the word "discovery" may refer to the independent variables (e.g., the environmental conditions), to the dependent variables (i.e., the outcomes), or lastly, to mediating variables or intervening events (the covert behavior of the subject presumably involved in the very act of discovery).

Because of this confusion regarding the meaning of the term, a large number of the participants agreed with Howard Kendler in his final summary statement in which he expressed the view that the term "discovery" is a useless concept and should be abandoned in psychological research; far more valuable terms are available for research to describe these phenomena.

Others felt, however, that "Learning by Discovery", as an expression, seemed to be useful for curriculum and instruction. While they agreed that the term needed clarification, they argued that its use by teachers would lead to superior teaching. Some participants felt that, although further clarification was desirable, a completely precise definition of the term would be unattainable; the very concept of "discovery" suggests the unknown and hence undefinable.

A major contribution of the conference consisted of a comprehensive review of the research. This critical survey, with over 200 references was carried out in a more comprehensive fashion than has ever been done before. Furthermore, the quality of these various studies was critically analyzed and discussed for the first time.

This careful review of the literature demonstrated that, although much has been written on the topic, no evidence has been accumulated to support the hypothesis that teaching through the use of a method of "learning by discovery" or the use of "inductive teaching" is more effective than direct, well-organized instruction. There is no dependable evidence, for example, that having students discover a principle for themselves is superior to direct instruction, either for acquiring a thorough understanding of that principle or for long-term retention. Certain initial findings that learning by discovery resulted in increased motivation have subsequently been reversed and have been found to be ascribable to a short-term novelty effect. Even as a means of teaching students how to discover, direct instruction on specific strategies was not less effective than having children engage in "discovery" activities.

These negative findings must be interpreted in view of the fact that many of the best studies in the field involve some form of "guided discovery." All Conference participants agreed that, as one speaker put it, "Pure discovery does not exist." The learner must be given some assistance, either in the form of preparation prior to the learning in question, or in the form of guidance during instruction. From the point of view of educational research, therefore, the critical question appeared to be "How much and what kind of guidance should teachers give?" When the question is posed this way, it offers clear direction for research questions.

A number of interesting suggestions were presented to the conference regarding the ways in which the discovery process may be guided. These ranged from highly specific techniques to general approaches. One set of suggestions consisted of a number of principles of teaching mathematics in which, for example, children are led to formulate hypotheses and then are presented with situations where these hypotheses are "torpedoed;" i.e., that is, where they no longer are appropriate. While no evidence was presented to show how effectively these techniques work when used by other teachers, these practical teaching suggestions may prove helpful to future researchers who are seeking fruitful hypotheses for research investigations.

One speaker suggested that research questions should be posed in a far more restricted fashion, rather than attempting to evaluate "learning by discovery" as a general method. Future studies should seek to determine, for a particular subject field and for a specified population of students, the value of

a certain kind and amount of inductive activity. Research would be greatly improved if a larger variety of criteria were adopted; the outcomes to be measured should include, for example, retention and transfer, attitude toward the subject, and effects on originality and independence.

It was pointed out that research studies require far better control of variables during instruction; for example, it is important to deal carefully with the time factor, since experimental groups frequently differ materially in terms of the time they take to complete the treatment. Furthermore, the task assigned the subjects should not be purely arbitrary like the learning of some alphabetic code; it should constitute, in its own right, an important part of classroom learning.

Was it a mistake to invite scholars with such different points of view to this conference? It is true that a good deal of time was spent on broad fundamental educational questions, rather than on the specific problems of research. A large part of the discussions was carried on at more than one level. However, in retrospect, it seems essential to have occasional research conferences of this type. Of course, it is important to bring together scholars with common assumptions and agreed-upon strategies. Such a task force may accomplish far more in clarifying a field and formulating research discussions within it. On the other hand, in a conference like the one on "Learning by Discovery," where scholars represented a wide diversity of backgrounds, many issues which seem hazy and beyond the pale of science to one scholar may stimulate another investigator to formulate fruitful hypotheses in a testable form. Opportunities for this kind of dialogue may result in bringing new areas of inquiry within the scope of scientific research.

The published proceedings of the conference should provide a permanent contribution to the field of education. Within the pages of one book appear, for the first time, the original papers of leading scholars who have been identified with different approaches to this problem. The report of the discussions and the concluding statements present a summary of the stimulating interchange and reveal some of the issues in this area. Readers of the volume, therefore, will find for their scrutiny the contributions of these thinkers as well as a report of the interactions. It seems assured that the kind of questions which will be raised in future educational research on this topic and the procedures adopted to find the answers will be inevitably influenced by the proceedings of this conference.

APPENDIX A

List of Participants for Research Conference on "Learning by Discovery" New York City, January 28, 29, 1965

1. Richard Atkinson
   School of Education
   Stanford University

2. Jerome Bruner
   Center for Cognitive Studies
   Harvard University

3. Lee J. Cronbach
   School of Education
   Stanford University

4. Robert Davis
   The Madison Project
   Webster College
   St. Louis, Missouri

5. Robert Gagné
   American Institute for Research
   Pittsburgh, Pennsylvania

6. Eleanor J. Gibson
   Department of Psychology
   Cornell University

7. Robert Glaser
   Learning Research and Development Center
   University of Pittsburgh

8. David Hawkins
   Educational Services, Inc., and
   Department of Philosophy
   University of Colorado

9. Jerome Kagan
   Department of Social Relations
   Harvard University

10. Robert Karplus
    Elementary Science Curriculum Project
    University of California
    Berkeley

11. Evan R. Keislar
    Department of Education
    University of California
    Los Angeles

12. Howard H. Kendler
    Department of Psychology
    University of California
    Santa Barbara

13. Bert Y. Kersh
    Center for Teaching Research
    Oregon State System of Higher Education
    Monmouth, Oregon

14. George Miller
    Department of Psychology
    Harvard University

15. Lloyd Morrisett
    Carnegie Corporation of New York

16. Sonia Osler
    Children's Psychiatric Services
    The Johns Hopkins Hospital

17. Walter R. Reitman
    Department of Psychology
    Carnegie Institute of Technology
    Pittsburgh, Pennsylvania

18. Lee Shulman
    College of Education
    Michigan State University

19. Michael Wallach
    Department of Psychology
    Duke University

Appendix A (Cont.)

Conference on "Learning by Discovery"

20. Sheldon H. White
Department of Psychology
University of Chicago

21. David Wiley
Department of Education
University of California
Los Angeles

22. Merlin Wittrock
School of Education
University of California
Los Angeles

Staff

23. Rowland Mitchell
Social Science Research Council
New York

Observers

24. Richard Suchman
Cooperative Research Branch
U. S. Office of Education
Washington, D. C.

25. Charles Whitmer
Course Content Improvement Section
National Science Foundation
Washington, D. C.

26. Rosslyn G. Suchman
Office of Naval Research and
Gallaudet College

APPENDIX B

OUTLINE FOR PUBLICATION OF CONFERENCE PROCEEDINGS

TITLE: Learning by Discovery; A Critical Appraisal

EDITORS: Lee S. Shulman and Evan R. Keislar

TABLE OF CONTENTS:

1. Preface
2. Introduction

Part I: THE ISSUE

3. Learning the Unteachable
   David Hawkins
4. Variables in Discovery Learning
   Robert Glaser
5. Discussion: The Meaning of Discovery in Learning

Part II: THE RESEARCH

6. The Learning by Discovery Hypothesis: A Review of Literature
   M. C. Wittrock
7. The Logic of Experiments on Discovery
   Lee J. Cronbach
8. Discussion: Educational Objectives

Part III: THE CURRICULUM

9. Some Elements of Discovery
   Jerome S. Bruner
10. Discovery in the Teaching of Mathematics
    Robert B. Davis
11. Discussion: Teaching and Discovery

Part IV: PSYCHOLOGICAL INSIGHTS

12. Varieties of Learning and the Concept of Discovery
    Robert M. Gagné
13. Learning, Attention and the Issue of Discovery
    Jerome Kagan
14. Discussion: Psychological Inquiry and Educational Practice

Part V: THE CONFERENCE: RETROSPECT AND PROSPECT

15. Reflections on the Conference
    Howard H. Kendler
16. Further Reflections
    Lloyd N. Morrisett

17. The Problem of Discovery: Conference in Retrospect
Evan R. Keislar
Lee S. Shulman
18. Bibliography and Author Index
19. Subject Index